CLAIMS

[1] A semiconductor laser device having a semiconductor laser layer formed on one face of a semiconductor substrate, and having a first type electrode and a second type electrode provided on a semiconductor laser layer side and a semiconductor substrate side, respectively, so as to sandwich the semiconductor laser layer and the semiconductor substrate therebetween,

wherein the first type electrode includes a first electrode and a second electrode that covers the first electrode.

[2] The semiconductor laser device according to claim 1,

wherein the semiconductor laser layer has a stripe-shaped and raised ridge formed therein,

wherein the first electrode is so formed as to cover at least a top portion of the ridge, and

wherein the second electrode is so formed as to have an area smaller than an area occupied by the semiconductor laser layer.

[3] The semiconductor laser device according to claim 2,

wherein the second electrode is so formed as to be away from edges of the semiconductor laser layer.

[4] The semiconductor laser device according to claim 3,

wherein a distance away from the edges of the semiconductor laser layer is 10 μm or more but 30 μm or less.

[5] The semiconductor laser device according to claim 1,

wherein a film thickness of the first electrode is thinner than a film thickness of the second electrode.

[6] The semiconductor laser device according to claim 5,

wherein the film thickness of the first electrode is 10 nm or more but 30 nm or less.

[7] The semiconductor laser device according to claim 1,

wherein the semiconductor laser layer has a plurality of stripe-shaped and raised ridges formed therein,

wherein the first electrode is so formed as to cover at least a top portion of each ridge, and

wherein the second electrode is so formed as to have an area smaller than an area occupied by the semiconductor laser layer corresponding to each ridge.

[8] The semiconductor laser device according to claim 7,

wherein the semiconductor laser layer has a groove for separating the plurality of ridges from each other, and

wherein the first electrode is formed within an area occupied by each semiconductor laser layer separated by the groove.

[9] A method for fabricating a semiconductor laser device having a semiconductor

laser layer formed on one face of a semiconductor substrate, and having a first type electrode and a second type electrode provided on a semiconductor laser layer side and a semiconductor substrate side, respectively, so as to sandwich the semiconductor laser layer and the semiconductor substrate therebetween,

wherein the first type electrode includes a first electrode and a second electrode that covers the first electrode, and

wherein a first type electrode forming step includes

a first electrode forming step of forming the first electrode, and

a second electrode forming step of forming the second electrode.

[10] The method for fabricating a semiconductor laser device according to claim 9, further comprising:

a ridge forming step of forming a stripe-shaped and raised ridge in the semiconductor laser layer,

wherein, after the ridge forming step is performed, the first electrode forming step is performed so that the first electrode is so formed as to cover at least a top portion of the ridge, and

wherein the second electrode forming step is performed so that the second electrode is formed on the first electrode so as to have an area smaller than an area occupied by the semiconductor laser layer.

[11] The method for fabricating a semiconductor laser device according to claim 10,

wherein, in the second electrode forming step, the second electrode is so formed as to be away from edges of the semiconductor laser layer.

[12] The method for fabricating a semiconductor laser device according to claim 9, further comprising:

a ridge forming step of forming a plurality of stripe-shaped and raised ridges in the semiconductor laser layer,

wherein, after the ridge forming step is performed, the first electrode forming step is performed so that the first electrode is so formed as to cover at least a top portion of each ridge, and

wherein the second electrode forming step is performed so that the second electrode is formed on the first electrode so as to have an area smaller than an area occupied by the semiconductor laser layer corresponding to each ridge.

[13] The method for fabricating a semiconductor laser device according to claim 12, further comprising:

a groove forming step of forming a groove in the semiconductor laser layer for separating the plurality of ridges from each other, the plurality of ridges formed by the ridge forming step,

wherein, in the first electrode forming step, the first electrode is formed within an area occupied by each semiconductor laser layer separated by the groove formed by the groove forming step.

[14] The method for fabricating a semiconductor laser device according to claim 9, wherein at least one of the first and second electrodes is formed by lift-off.

[15] The method for fabricating a semiconductor laser device according to claim 12,

wherein the semiconductor laser layer forming process for forming a semiconductor laser layer in which the plurality of ridges are formed includes a plurality of semiconductor laser portion forming steps of forming semiconductor laser layers corresponding to the different ridges,

wherein the plurality of semiconductor laser portions forming steps each include

a plurality of stages of semiconductor crystal growth steps, and

a plurality of removing steps of removing semiconductor laser layers formed by the different stages of semiconductor crystal growth steps.

[16] The method for fabricating a semiconductor laser device according to claim 15,

wherein the plurality of removing steps are performed in different stages, and

wherein each removing step removes a corresponding one of the semiconductor laser layers formed by the different stages of semiconductor crystal growth steps.

[17] The method for fabricating a semiconductor laser device according to claim 15,

wherein, in the different stages of semiconductor crystal growth steps, a crystal growth temperature in a later semiconductor crystal growth step is made lower than a crystal growth temperature in an earlier semiconductor crystal growth step.

[18] A ridge stripe semiconductor laser device comprising an active layer, upper and lower clad layers that sandwich the active layer therebetween, a stripe-shaped

ridge formed in part of the upper clad layer, and a current block layer that covers both sides of the stripe-shaped ridge other than a top face thereof,

wherein a first electrode is formed on an upper face of the semiconductor laser device, and a second electrode is formed on the first electrode,

wherein the first electrode is made thinner than the second electrode, and is so formed as to cover at least an entire area of the top face of the ridge, and

wherein the second electrode is formed at a given distance away from both stripe-direction ends of the ridge.

[19] A multibeam semiconductor laser device comprising, on a common semiconductor substrate, a plurality of ridge stripe semiconductor laser portions, each comprising an active layer, upper and lower clad layers that sandwich the active layer therebetween, a stripe-shaped ridge formed in part of the upper clad layer, and a current block layer that covers both sides of the stripe-shaped ridge other than a top face thereof,

wherein a first electrode is formed on an upper face of each of the semiconductor laser portions, and a second electrode is formed on the first electrode,

wherein the first electrode is made thinner than the second electrode, and is so formed as to cover at least an entire area of the top face of the ridge, and

wherein the second electrode is formed at a given distance away from both stripe-direction ends of the ridge.

[20] The semiconductor laser device according to claim 19,

wherein, between the plurality of semiconductor laser portions, a groove for

electrically separating the semiconductor laser portions from each other is formed, and

wherein the first electrode is formed away from the groove.

[21] A method for fabricating a ridge stripe semiconductor laser device comprising an active layer, upper and lower clad layers that sandwich the active layer therebetween, a stripe-shaped ridge formed in part of the upper clad layer, and a current block layer that covers both sides of the stripe-shaped ridge other than a top face thereof, the method for fabricating a ridge stripe semiconductor laser device comprising:

a first electrode forming step of forming a first electrode in such a way that at least an entire area of the top face of the ridge is covered therewith;

a second electrode forming step of forming a second electrode on the first electrode; and

a cleaving step of cleaving a facet of the semiconductor laser device that intersects the stripe-shaped ridge at right angles,

wherein, in the first electrode forming step, the first electrode is made thinner than the second electrode, and

wherein, in the second electrode forming step, the second electrode is formed at a given distance away from both stripe-direction ends of the ridge.

[22] A method for fabricating a multibeam semiconductor laser device, the multibeam semiconductor laser device comprising, on a common semiconductor substrate, a plurality of ridge stripe semiconductor laser portions, each comprising an active layer, upper and lower clad layers that sandwich the active layer therebetween,

a stripe-shaped ridge formed in part of the upper clad layer, and a current block layer that covers both sides of the stripe-shaped ridge other than a top face thereof, the method for fabricating a multibeam semiconductor laser device comprising:

a first electrode forming step of forming a first electrode in such a way that at least an entire area of the top face of each ridge is covered therewith;

a second electrode forming step of forming a second electrode on the first electrode; and

a cleaving step of cleaving a facet of the semiconductor laser device that intersects the stripe-shaped ridge at right angles,

wherein, in the first electrode forming step, the first electrode is made thinner than the second electrode, and

wherein, in the second electrode forming step, the second electrode is formed at a given distance away from both stripe-direction ends of the ridge.

[23] The method for fabricating a semiconductor laser device according to claim 22, further comprising:

a groove forming step of forming a groove between the plurality of semiconductor laser portions for electrically separating the semiconductor laser portions from each other,

wherein, in the first electrode forming step, the first electrode is formed away from the groove.

[24] The method for fabricating a semiconductor laser device according to claim 21, wherein at least one of the first electrode forming step and the second electrode

forming step uses lift-off for electrode formation.

[25] The method for fabricating a semiconductor laser device according to claim 22, wherein crystal growth including first crystal growth and second crystal growth is performed on the semiconductor substrate for forming a first semiconductor laser portion,

wherein, after a crystal grown by the first and second crystal growth in another region other than where the first semiconductor laser portion is left is removed, crystal growth is performed on the semiconductor substrate for forming a second semiconductor laser in the another region on the semiconductor substrate,

when the crystal grown by the first and second crystal growth in the another region is removed, the method for fabricating a semiconductor laser device further comprising:

a second crystal growth layer removing step of removing the crystal grown by the second crystal growth in such a way that a layer of the crystal grown by the first crystal growth is exposed; and

a first crystal growth layer removing step of removing the crystal grown by the first crystal growth.

[26] The method for fabricating a semiconductor laser device according to claim 25, wherein a growth temperature at a time of the second crystal growth is so set as to be lower than a growth temperature at a time of the first crystal growth.